

20. (New) The coating of claim 19 wherein said alkoxide precursor is a non-transition metal alkoxide.

### Remarks

Claims 1-11 were originally pending in this case. Claims 1 and 10 are amended above. New claims 12-20 have been added. Thus, claims 1-20 are now pending.

Claims 1-7 and 10-11 stand rejected under 35 USC 102(b) as being anticipated by Barrow et al. (US Patent No. 5,585,136) and a product description of "Spin-on-Glass" (Semiconductor Online: Product Showcase of "Spin-on-Glass" by Honeywell), and as being anticipated by Schmidt et al. (US Patent No. 5,766,680). The rejections are respectfully traversed.

#### **1. Explanation of Amendments**

Claims 1 and 10 have been amended to clarify that the claimed Ormosil composite includes an organic-inorganic hybrid polymeric matrix within there is trapped a plurality of inorganic particles of a size of at least one (1) micron. This is not a narrowing amendment, insofar as Ormosils are defined in the specification as such. (See ¶ 7 "Organically modified silicates (Ormosils) are well known hybrid organic-inorganic materials"; ¶ 9 "... hydrolysis and condensation reactions ... to form a polymeric network; see also FIG. 1).

#### **0 2. Barrow et al., U.S. Patent 5,585,136 (as supplemented with Spin-on-Glass)**

The Barrow et al. patent describes the preparation of "... thick ceramic films of greater than 10  $\mu\text{m}$  ..." by mixing a selected organometallic sol-gel solution with up to 90% by weight of the solution of a selected, finely divided ceramic powder so as to produce a uniform stable dispersion. This material is then applied to a coating substrate and said coated substrate is fired at a temperature to between 400 °C and 1000 °C so as to remove organic constituents and produce a stable, crack-free, polycrystalline metallic oxide film on said substrate. Barrow et al.

only envision ceramic films in their patent (US Pat. No. 5,585,136); *organic constituents, including byproducts such as those resulting from the hydrolysis of organo-metallic reagents, are clearly and specifically removed through high temperature treatments.* Relevant examples of discussion contained therein include:

As noted above, sol-gel processing techniques first require the preparation of an organo-metallic solution of the desired ceramic oxide precursors in an organic solvent, followed by hydrolysis and pyrolysis to remove the organic phase. (Column 2, lines 65-67 and Column 3, lines 1-3).

Following deposition of the ceramic/sol gel paint on the substrate, it is heated in air between 400 °C. and 700 °C., depending upon the particular substrate and coating, for a period of 1 to 30 minutes so as to remove the organic materials and form the oxide compounds." (Column 4, lines 45-49).

It is well known that organic constituents are generally not stable at temperatures greater than 350 °C. Barrow et al. frequently refer in their patent to thermal processing temperatures of greater than 400 °C for the specific purpose of thermally-decomposing and eliminating all residual organic content from their films.

In accordance with the present invention, and unlike prior-art coatings described by Barrow et al., relatively large and dense particles are added to the Ormosil (organically modified silicate) solution. The Ormosil solution is formed through the hydrolysis and condensation of chemically-multifunctional, organically modified silanes with alkoxide precursors. Such systems, which produce hybrid organic-inorganic polymer networks, are completely different from the monofunctional organometallic sol-gel solutions described in the patent by Barrow et al. In the absence of high-temperature thermal treatments, hybrid Ormosil films retain a mixture of inorganic (e.g., chemical inertness) and organic (e.g., flexibility) polymer character. In contradistinction to the cited disclosure, the compositions of the present application are formed at low temperature (typically room temperature). This is done specifically to incorporate and retain

the chemical and mechanical characteristics imparted by the organic ligand components (such as acrylate, vinyl, and/or epoxide substituents) of the Ormosil precursors.

The pending claims capture the differences between the present invention and Barrow et al. as they, now explicitly, call out the organic-inorganic hybrid polymeric matrix which is clearly from Barrow et al. due to the difference in the preparative methods (especially thermal processing) and targeted chemical/mechanical functionalities.

### 1 3. "Spin-on-Glass"

Spin-on-Glass is a well-known coating system used in the microelectronics industry to passivate and planarize semiconductors, substrates, and other device and circuitry elements used in the electronics industry. The passivation characteristics are derived, at least in part, through the hydrophobic nature of methyl side groups linked to a polysiloxane backbone. As such, the polymeric nature of Spin-on-Glass is solely due to the *inorganic* polysiloxane network backbone; the organic methyl groups in such systems do not participate in the formation of a network polymer. Spin-on-Glass does not incorporate particles of any type.

The present invention specifically employs polymerizing organic side-chains in the Ormosil precursor; the specification lists acrylates, vinyls, and epoxides as example side group species. The composite coating system specifically incorporates (a) an organic-inorganic hybrid polymer materials matrix with (b) hard particles. The class of materials has been specifically designed to protect metallic substrates, such as aircraft aluminum alloys, from corrosion through the unique mechanical and electrochemical properties imparted by the integration of size-specific hard particles into the organic-inorganic polymer hybrid matrix. Outside of the common usage of metalorganic precursors, Spin-on-Glass bears little resemblance to the present invention.

## 2 4. Schmidt et al., U.S. Patent 5,766,680

As per the title of the invention of Schmidt et al., "Method of Producing Structured Inorganic Layers", the disclosure focuses on the development of a *purely inorganic* film system. This is done through a sol-gel process, employing conventional alkoxide and Ormosil precursors and "fine-scaled filler" or metallic nanoparticles. The purely inorganic-phase film system is derived, similar to the work by Barrow et al., through high-temperature processing which leads to thermal decomposition of the organic phase constituents. Excerpting from the patent by Schmidt et al.:

[T]he applied system is structured and the structured coating is thermally densified to form a structured layer, the profile of the structure remaining unchanged. (Column 1, lines 36-40).

In the thermal densification, a continuous transformation from an organically-modified glass (or ceramic, respectively) to a purely inorganic (carbon-free)  $\text{SiO}_2$  glass (or ceramic, respectively) takes place. (Column 1, lines 55-59).

[P]ost-treatment is preferably effected (after removal from the mold) at temperatures in excess of  $250^\circ\text{C}$ ., preferably in excess of  $400^\circ\text{C}$ ., and particularly preferred in excess of  $500^\circ\text{C}$ . Generally, the thermal densification is carried out in the range of from  $400^\circ$  to  $700^\circ\text{C}$ . (Column 4, lines 48-52).

The two example process descriptions provided by Schmidt et al. each cite processing temperatures of  $500^\circ\text{C}$  or greater (Column 5, lines 19 and 44).

As described above, the coating systems of the present invention employ, as a seminal element, a residual organic component as a key functional component of the organic-inorganic hybrid network. Like the earlier work by Barrow et al., Schmidt and coworkers specifically destroy the organic component of their films, via thermal decomposition, to attain structured layers that are purely inorganic (carbon-free, as Schmidt states).

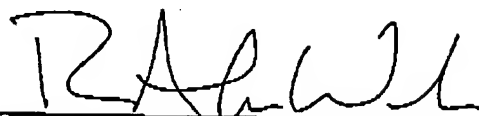
The disclosure of Schmidt et al. also differs in a second important aspect. The patent fails to teach or suggest the use of particles within the size regime claimed herein. In Schmidt et al., fine-scale fillers, comprised of metal oxides and non-metals, employed in an amount of less than 50% (20-30% preferred), are utilized. In all cases, the "appropriate" particle size is less than 1 micron (complete regime envisioned ranges in size from 1 nm to 1 micron; preferred size range is 1 to 300 nanometers) (Column 3, lines 26-38). Carbon black pigments having a particle diameter of less than 500 nm (Column 3, lines 61-62) and metallic nanoparticles, ranging in size from 1 to 100 nm (2 to 30 nm preferred) were also envisioned by Schmidt et al. (Column 3, lines 66-67 and Column 4 lines 1-3 and lines 12-14). In no case does Schmidt et al. envision the utilization of particles (oxides, nonmetals, or metals) of greater than 1 micron in size.

The present invention utilizes particles of at least 1 micron in size. Thus, the inventive coating, which is based on (1a) organic-inorganic hybrid materials containing significant residual organic functionality and (1b) containing large (e.g., at least 1 micron) particles, is clearly distinguished from the cited references which are focused on the development of (2a) structured "purely inorganic" coatings attained through high-temperature processing (e.g., 500° C or greater), and (2b) containing small particles (e.g., less than 1 micron).

Considering the foregoing, it is sincerely believed that this case is in a condition for allowance, which is respectfully requested.

This paper is intended to constitute a complete response to the outstanding Office Action. Please contact the undersigned if it appears that a portion of this response is missing or if there remain any additional matters to resolve. If the Examiner feels that processing of the application can be expedited in any respect by a personal conference, please consider this an invitation to contact the undersigned by phone.

Respectfully submitted,



**SIGNATURE OF PRACTITIONER**

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